

girls and may have begun to decline. The prevalence of smoking by boys of this age peaked in 1970 and has shown a steady decline since that time. These trends may represent fewer adolescents taking up smoking, with those who do beginning at an earlier age.

Well over one-half of high school seniors—male and female—who smoke regularly, reported first smoking in the ninth grade or earlier (101). It is hard to know whether this earlier onset reflects something specific to cigarette smoking or is attributable to the more general pattern of earlier onset of all “adult-type” behaviors.

This trend toward early initiation of smoking behavior may have a significant impact on the future health of these adolescents, as many of the health risks associated with smoking increase with both earlier onset of smoking and duration of the smoking habit. In addition, the earlier the use of a substance is begun, the longer it is likely to be continued and the more heavily it is likely to be used (26,102,137).

These national surveys do not permit a detailed examination of the initiation process. “Experimenters,” those who have smoked at least a few puffs of a cigarette, but not more than 100 cigarettes, are grouped with “never smokers”, those who have never taken even a few puffs. “Occasional” smokers are defined as those who smoke less than one cigarette a week but more than 100 cigarettes in a lifetime. Occasional or intermittent smoking is rare among adults. Examining the proportion of “experimenters” at each age and following their subsequent smoking behavior might help clarify the determinants of the initiation process (126).

In one major British study, smoking only a few cigarettes usually led to becoming a regular smoker; only 15 percent of those who smoked more than a single cigarette escaped adoption of smoking as a regular behavior (126). The estimate in this study of 8 percent “occasional smoking” in adolescence is based on a definition of smoking less than daily, but at least one cigarette a week for as long as 1 month. The difference in definition of occasional smoking makes comparison with current U. S. data on adolescents difficult. From 1968 to 1979, the percentage of current occasional smokers (less than once per week) varied between 0.4 percent and 1.6 percent for girls, and 0.4 percent and 2.3 percent for boys (130). McKennell and Thomas estimated that the mean length of time between smoking the first cigarette and adopting regular (daily) smoking was slightly less than 3 years for boys and slightly more than 2 years for girls (126). The difference is probably due to earlier experimentation among boys. The transition from experimental or occasional

TABLE 2.—Percent of adolescents currently using* cigarettes, alcohol and marihuana, by sex: three national surveys compared

Ages 12-18 NIE (1979)				Ages 12-17 Abelson, et al. (1977)			Ages 17-19 High School Seniors Johnson, et al. (1977)		
Ages	1974	1979		Ages	1974	1977	Ages	1975	1977
Current Cigarette Use									
12-14	F 5.1	4.3		12-13	13	10		—	—
	M 4.2	3.2							
15-16	F 21.6	12.3		14-15	25	22		—	—
	M 18.1	14.6							
17-18	F 26.4	27.0		16-17	38	35		—	—
	M 32.6	19.6							
12-18	F 15.9	13.1		12-17	F 24	22	17-19	F 35.9	39.6
	M 16.3	11.1			M 27	23		M 37.2	36.6
Current Alcohol Use									
				16-17	F&M 51	52			
				12-17	F 29	25	17-19	F 62.2	65.0
					M 39	37		M 75.0	77.8
Current Marihuana Use									
				16-17	F&M 20	29			
				12-17	F 11	13	17-19	F 22.5	30.0
					M 12	19		M 32.3	40.7

*NOTE: Definition of current use varies by study. Cigarettes: NIE (1979)—current regular smoker (one or more cigarettes during the past week over and above a minimum five packs) and current occasional smoker (less than one cigarette per week); Abelson, et al. (1977) and Johnston, et al. (1977)—smoked within the past 30 days. Alcohol and marihuana: use within the past month (smokers and nonsmokers).

SOURCE: Abelson, H.I. (2), Johnston, L.D. (101), National Institute of Education (130).

smoking to regular smoking is an extremely important one to study because it may provide a crucial period for intervention before psychosocial or pharmacological dependency is established.

Number of Cigarettes Smoked

In the NCSH/NIE survey (130), a smaller percentage of female smokers than male smokers smoked 10 or more cigarettes per day (61.8 percent versus 73.8 percent in 1974, and 59.0

percent versus 65.6 percent in 1979). The high school senior survey showed male-female rates to be equivalent at the half-pack per day rate, with boys exceeding girls at heavier levels (101). In that study, the proportion of females currently smoking as much as a half-pack per day increased between 1975 and 1977, while the proportion of males smoking at that rate remained constant. The American Cancer Society survey also suggested an increase in the proportion of heavy smokers among adolescent girls compared with stable rates in boys between 1969 and 1975 (216). It reported a fourfold increase in the percentage of female smokers who smoked at least a pack a day, from 10 percent to 39 percent, compared with an unchanged rate of 31 percent among males. The equality in smoking behavior may be extending to the number of cigarettes smoked.

Type of Cigarette Smoked

In adolescent smokers of both sexes, there has been a definite trend toward smoking cigarettes with lower "tar" yields between 1974 and 1979. Figure 1 shows the decline in the "tar" and nicotine levels of the cigarettes smoked by adolescents. Girls appear to be slightly ahead of boys in the use of lower "tar" cigarettes. The trend can be attributed to three factors: the increased marketing of low "tar" cigarettes; the decreased "tar" levels of existing cigarettes; and increased awareness of differential health hazards associated with different kinds of cigarettes (130). It should be noted, however, that the midpoint on the cumulative percentage continuum has dropped only about 1 mg "tar" between 1974 and 1979, from approximately 17.5 mg to approximately 16.5 mg, and the percentage of adolescents smoking the lowest category of "tar" (less than or equal to 10 mg) is still very small.

Smoking Cessation

Are there differences between girls and boys in patterns of smoking cessation comparable to those observed in adults? A greater proportion of adult males than adult females have quit smoking (see the section on adult smoking cessation in this part). Two national surveys have shown more ex-smokers among adolescent boys than among girls (101,130). Looking at either the percentage of ex-smokers among all adolescents or at the quit rates (number of former smokers divided by number of ever smokers), boys exceed girls in every survey between 1968 and 1979 (130). However, if experimental smokers are eliminated from the analysis, there are no differences between the boys and girls. For the two most recent surveys, the quit rates

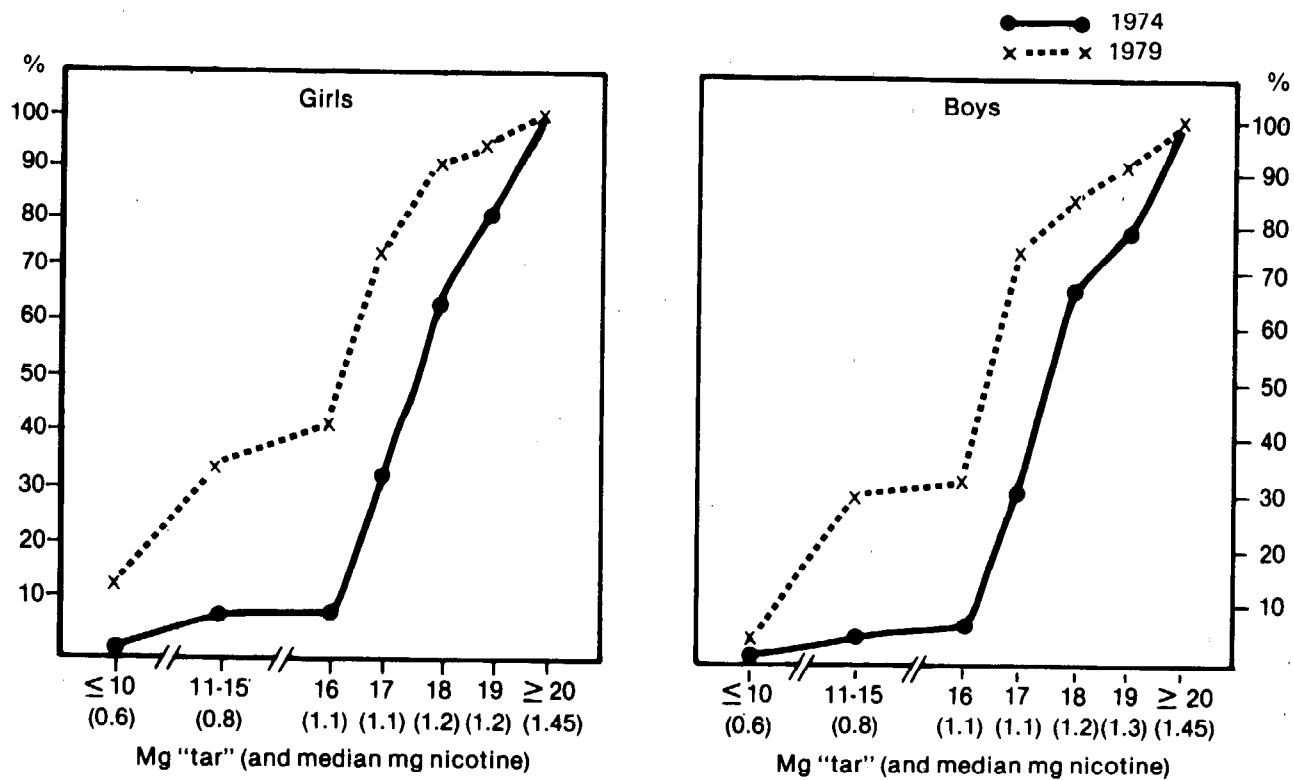


FIGURE 1.—Cumulative percentage of adolescent smokers by the tar level of cigarette smoked, 1974 and 1979

SOURCE: Federal Trade Commission (61), National Institute of Education (130).

were as follows: 33.2 percent of female and 36.0 percent of male smokers had quit in 1974; 30.5 percent of female and 42.3 percent of male smokers had quit in 1979. In contrast, Reeder found no difference in quit rates between boys and girls aged 13 to 19 in national surveys conducted in 1965 (boys 28 percent, girls 29 percent) and in 1975 (boys 34 percent, girls 35 percent) (148). Therefore, it is unclear whether adolescent girls show the same patterns of quitting smoking found in adult women. It should also be remembered that research on both smoking cessation and illicit drug use has shown that quitting is often not a permanent state (100,147,173).

Smoking Prevalence and Ethnicity

There are no data based on a national sample examining adolescent smoking in different racial groups. However, beginning in 1969-1970 Brunswick has conducted a longitudinal personal home interview survey of a representative sample of 668 urban, non-Hispanic black youths in Harlem, New York City. She found that more 16 to 17 year old girls than boys smoked (62 percent versus 50 percent). This was well before national rates had shown smoking among girls equaling and then exceeding that among boys. This greater smoking prevalence in girls continued into the young adult years. The same subjects were reinterviewed 6 to 8 years later, when the youths were aged 18 to 23. Sixty-two percent of young black women (N = 258) were current smokers and 18 percent were currently smoking at least a pack a day. This is compared with 57 percent of the black men 18 to 23 years old (N = 277) who were current smokers, 16 percent of whom regularly smoked at least a pack a day. These prevalence rates are well above the rates for adult black women found in national survey data, but are only slightly higher than the rates found in adult black men (198). This study is of substantial interest, but may not be representative of national black adolescent smoking patterns.

Alcohol and Marijuana Use

Cigarette use should be viewed in the context of other substance use behaviors. Abelson, et al., provided information on the use of other substances in the age range of 12 to 17 by current cigarette smokers and by those not currently smoking (2). Smokers far exceeded nonsmokers in reporting use of alcohol, marijuana and/or hashish, or "stronger" drugs (hallucinogens, cocaine, heroin, and other opiates): positive replies for alcohol were 80.0 percent versus 44.8 percent; for marijuana and/or hashish, 68.3 percent versus 16.7 percent; and for

stronger drugs, 26.3 percent versus 4.1 percent respectively (24, 103,130,216). Similar figures for alcohol use by 13 to 17 year old girls were reported by Yankelovich, et al.: 81 percent of the smokers drank compared with 42 percent of nonsmokers, but somewhat lower estimates were reported for marihuana use—25 percent of the smokers versus 3 percent of the nonsmokers (203). Strong associations between alcohol use and cigarette smoking and/or between marihuana use and cigarette smoking in adolescents and college students have also been identified in a number of other investigations (86,97,153, 177,181).

DEMOGRAPHIC AND PSYCHOSOCIAL CORRELATES OF SMOKING IN ADOLESCENCE

Smoking is a complex behavior, and it is likely that adolescents start to smoke for multiple reasons. Strong correlations between smoking and a number of demographic and psychosocial variables have been reported, but causal connections have not been established. Neither has the set of “predisposing factors” been often subjected to multivariate analysis. It is rare that more than one or two variables have been tested simultaneously. What appear to be separate determinants of smoking behavior (for example, peer pressure and socioeconomic status) may actually be reflecting a single underlying pattern. For example, aspects of self-confidence, academic achievement, types of parental and/or peer relations, and/or socioeconomic factors cluster in certain ways to influence susceptibility to smoking cigarettes. A few multivariate analyses have been conducted (111,113,138).

Socioeconomic Influences

A number of studies have examined smoking in relation to socioeconomic status. The findings consistently point to a relationship between lower parental status—income and education—and higher smoking prevalence among these parents and their children (20,130,148,161). Adolescents from low-income families may also begin to smoke earlier than others (33,126). The findings that girls who work have higher rates of smoking may also reflect a relationship to lower economic status (9,130). Srole and Fischer observed a relationship between downward mobility and smoking in adults (180). This may be an important dynamic to explore in adolescent initiation of smoking.

A relationship between parental education and adolescent smoking also exists (130). When one or both parents attended

college, 9.9 percent of boys and 10.6 percent of girls smoked, compared with 10.9 percent of boys and 14.8 percent of girls from homes where neither parent attended college.

Family Patterns

In single-parent households (19.3 percent of those households surveyed in 1979), adolescent smoking rates were approximately double those of households in which both parents were present (130). This relationship holds for both boys and girls, in every age group, and across all five NCSH/NIE surveys; it has also been identified by others (111). In the 1979 survey, 19.3 percent of the boys and 21.2 percent of the girls in single-parent households are smokers, compared to 8.6 percent and 10.7 percent of those in homes with both parents present.

Parental modeling may underlie this association in two ways. First, adult smoking rates are higher for divorced or separated men and women. Second, female single parents who head households are likely to work outside the home, and smoking is more prevalent among working women than among homemakers (182).

Smoking Among Parents and Siblings

Adolescents are more likely to smoke if either or both parents smoke than if they do not (9,15,20,161,213). In the 1979 NIE Survey this pattern was found across age and gender (130) (See Table 3.) Looking at the data slightly differently, when both parents smoke, 13.5 percent of sons and 15.1 percent of daughters smoke; when one parent smokes, 9.1 percent of boys and 12.7 percent of girls smoke; and in homes where neither parent smokes, 5.6 percent of boys and 6.5 percent of girls smoke (130).

There are conflicting reports on the relationship between the sex of the smoking parent and smoking habits of the offspring. In two-parent homes in which only one parent smokes, 17 to 18 years olds appear to be more likely to smoke if the mother does (130). Other studies have identified a relationship between the child's smoking and that of the parent of the same sex (9,15,213). Allegrante, et al. found a relationship between the mother's smoking behavior and that of sons, but not of daughters, and no relationship of the father's smoking behavior to smoking by children of either sex (3). In contrast to all of these findings, Schneider, et al. were unable to relate parental smoking to that of offspring (166).

Explanations for the association between parental and children's smoking behavior include the effect of role-modeling, pa-

TABLE 3.—Percentage of adolescents who smoke by the smoking behavior of parents and older siblings

	Have No Older Sibling One or Both Parents Smoke	Have No Older Sibling Neither Parent Smokes	Older Sibling Smokes One or Both Parents Smoke	Older Sibling Does Not Smoke One or Both Parents Smoke	Older Sibling Smokes Neither Parent Smokes	Older Sibling Does Not Smoke Neither Parent Smokes
Boys:						
12-14	2.8	0.0	6.3	2.7	0.0	0.0
15-16	17.6	4.0	18.8	6.3	21.1	2.1
17-18	15.0	7.9	25.4	16.7	31.7	0.0
Total	8.2	2.9	17.0	7.5	19.5	0.6
Girls:						
12-14	3.7	0.0	8.5	1.3	3.4	2.9
15-16	8.2	5.7	20.0	13.0	15.2	2.4
17-18	29.7	15.4	32.9	19.6	25.0	6.7
Total	9.7	4.1	20.3	9.7	15.3	4.1

Base: Both parents present in household
SOURCE: National Institute of Education (130).

rental permissiveness (real or imagined), and availability of cigarettes in the home (125).

Older siblings seem equally important or more important than parents as potential role models for smoking (9,130,148). There is a greater likelihood that an adolescent will smoke if one or more older siblings smoke than if no older siblings smoke; this is true in those households where neither parent smokes as well as in those where one or both parents smoke. In the 1979 survey, boys with older siblings who smoked were more than three times as likely to smoke as boys with nonsmoking older siblings. The increase is about twofold for girls. The highest smoking rate for girls was found when at least one parent and an older sibling smoked (20.3 percent). The corresponding rate for boys (17.0 percent) was slightly lower than where an older sibling but neither parent smoked (19.5 percent) (130). (See Table 3.)

Peer Group Influence

Adolescents' smoking behavior is highly correlated with reports of having friends who also smoke (15,132,133,155,162,216). Most multivariate analyses have established this factor as being of prime importance although one such analysis found no relationship at all (3,113,138). It has been pointed out that patterns of drug use in adolescents are very similar among best friends (121). It has not been demonstrated, however, that it is the behavior of friends rather than inclinations of the adolescent which influences him or her to smoke (3,130,166).

Inquiring about the smoking behavior of the "four best friends" of adolescent respondents, the NIE study reported that 87.6 percent of boys and 94.0 percent of girls who smoked stated that at least one of those friends also smoked. In addition, only 10.2 percent of boys and 5.9 percent³ of girls who smoked had no regular smokers among their four best friends, and an even smaller fraction (2.2 percent of boys and 0 percent of girls) reported that none of their friends had even experimented. In a parallel vein, it was found that nonsmokers also congregate together. Approximately one-third of the nonsmokers (33.8 percent of boys, 32.9 percent of girls) reported having at least one best friend who smoked, while over two-fifths (43.0 percent of boys, 44.1 percent of girls) had no best friend who smoked regularly. Over one-fifth (22.4 percent of boys, 23.0 percent of girls) had no best friends who had even experimented.

Thus, "peer pressure" to smoke may be operative when the adolescent belongs to or would like to belong to a group in which smoking is part of the life-style (130). When the peer group be-

havior does not include smoking, there may be little pressure on the adolescent to begin to smoke.

Conformity pressures and peer influence are very strong in early adolescence. Therefore, if smoking were considered a behavior which was adopted by the majority of adolescents, experimentation and initiation might occur because of the importance of conformity in this age period (63). Unfortunately, there are suggestions that most adolescents tend to overestimate the proportion of their peers who are smokers. Eighty-two percent of all girls surveyed in the 1975 American Cancer Society Survey thought of adolescents as smokers rather than nonsmokers (216). In that same survey, the professions of teachers, executives, housewives, and feminist leaders were all characterized as smokers by approximately two-thirds of girls, with only doctors and athletes considered nonsmokers.

Heterosexual peer considerations may also be important. Girl smokers are very likely to have boyfriends who also smoke (72 percent), compared with nonsmoking girls (27 percent) (216). Similar percentages apply to the fraction of all male friends who smoke (69 percent for girl smokers and 32 percent for nonsmokers). Yet girls are less likely than boys to see smoking as a social asset (37 percent versus 55 percent) and they even consider it a drawback (52 percent girls versus 31 percent boys).

The kinds of images projected by the people shown in cigarette advertisements may lend support to peer influences to smoke. Girl smokers characterized such people as attractive (69 percent), enjoying themselves (66 percent), well-dressed (66 percent), sexy (54 percent), young (50 percent), and healthy (49 percent).

Prevention efforts aimed at making actual statistics on smoking prevalence available to teens in order to correct the above beliefs may help counter the advertising. Popular personages in various professions and lifestyles which girls mistakenly perceive as smoker-dominated could be recruited in this effort.

Scholastic Achievement and Aspiration

Achievement in school has been one of the most frequently investigated correlates of smoking, with a study as early as 1923 showing an association between poor school grades and smoking (15,83,121,137,143,161,212). Two studies have reported this association specifically for girls (35,216). Comparing the three factors—parental smoking, socioeconomic status, and scholastic performance—Borland and Rudolph identified scholastic performance as the strongest correlate of smoking in a sample of high school students (20). Studies of achievement, aspirations

and expectations in relation to smoking have found that reduced motivation and lower aspiration are associated with a higher prevalence of smoking (3,33,101,130). High school students in college preparatory courses were far less likely to smoke than students in any other type of curriculum (130). Smoking rates for boys and girls preparing for college (9.0 percent and 12.0 percent, respectively) were 50 to 60 percent of those in other curricula (18.3 percent of boys, 20.1 percent of girls). The same trend was found in a previous study (216). Smokers are less involved in extracurricular school activities and have a higher rate of absenteeism (9,35,137).

These factors are undoubtedly interrelated with social class and other factors. Sense of competency and sense of efficacy (or personal control) are linked to school achievement. Smokers have been reported to have less confidence that they can control what they will become (130). McAlister, et al. comment that high academic achievement is probably also associated with admission into a peer group in which smoking is not accepted (125). Furthermore, they state, "Educationally deprived young people may be somewhat less aware of the risks of smoking, but they also experience more stress and greater pressure to adopt behaviors that signal independence and maturity" (125).

Dynamic/Personality Factors

Up to this point, adolescent smoking has been described and analyzed in terms of discrete variables, many of which are truly not independent of one another. From them, a composite picture of the environment of the female smoker begins to emerge. Paralleling the behavioral descriptors is a set of individual/personality factors which include attitudes, values, beliefs, and perceptions which relate the adolescent to the world around her. Vitally important are feelings of self-worth, aspirations and expectations for the future, and feelings of efficacy, competence and the girl's view of her own smoking behavior.

Yankelovich, et al. have provided a thought-provoking description of the evolution in values which has occurred over the past 20 years (216). Smoking is just one behavior which may have been "suppressed" by social norms prescribing appropriate behavior for women in the past, and which now may be "disinhibited" in a very real sense.

Accompanying this shift in sanctions on female behavior is an increase in expressed rebelliousness among girl smokers, which was formerly more characteristic of boys. A higher percentage of female smokers than nonsmokers are annoyed by "experts"

who define what is good for them (53 percent versus 34 percent), agree that there is too much regulation of people's lives (50 percent versus 39 percent), and do not want to follow their parent's wishes regarding their behavior (almost 50 percent versus 26 percent) (216). Factor scores of male and female smokers similarly reflect a more negative "feeling toward authority" or dislike of adult-imposed restrictions than those of nonsmokers, and are approximately equal for both sexes (130). Clausen noted that girls who smoked were less acquiescent to their parents, more autonomous, and "strikingly higher in quest for power" than nonsmoking girls (33).

The evolution in values and sex-role behaviors has resulted in some interesting differences between male and female smokers (216). The male smoker remains more socially uneasy, expresses a greater need to be popular with the opposite sex, and considers smoking more of a social asset than the female smoker. The female smoker, compared with her nonsmoking peer, is more likely to consider parties a favorite leisure time activity, to have a boyfriend, and to have had sexual relationships (see also 174). In addition, she is less likely to feel nervous meeting new people. Finally, while she is more willing to admit that smoking is a drawback, she shows less acceptance than the male smoker of the stereotype that adolescents begin to smoke cigarettes to gain peer acceptance and approval (130,216). Nonsmokers show the greatest acceptance of this stereotype and the one which describes the smoker as a "show-off" (216), who believes that smoking makes one look "cool" or "grown-up."

In other studies of smoking behavior, self-esteem has usually been investigated in terms of the adolescent's self-confidence in interpersonal relationships. Smoking is ego enhancing and facilitates social functioning (122,123). This has been observed specifically among adolescent girls and female undergraduates who smoke (174,216). Smoking is correlated with a wish to be older (130). Both boys and girls who differed from the norms of their high school peers on tests of self-concept were more likely to smoke cigarettes as well as to use other drugs (95).

Adolescent smoking has been consistently correlated with low educational and occupational aspirations. In a review which included "locus of control" as a measured variable, Smith concluded that smokers were more externally oriented and felt that they had limited control over what happened to them (176). Pflaum reviewed findings on the positive relationship between smoking and feelings of helplessness and hopelessness (143). Adolescent smokers express less desire and ability than nonsmokers to control future events—for example, to determine what kind of person they will become (130). Girls scored slightly

higher than boys on this factor, indicating a greater sense of future control.

Finally, response to stress has been suggested as a basic dynamic in cigarette smoking (122). Feelings of unattractiveness, a sense of incompetency and inefficacy in school achievement and personal relations, limited opportunities for personal growth and for future social and economic roles all contribute to stress in adolescence. Changes in social settings, such as transition from elementary to junior high school, which occur simultaneously with physical and emotional changes must also be acknowledged. Theoretical formulations of life-change events and their effects on health might also be worth considering in studying the onset of cigarette smoking among girls (47).

Prediction of Future Smoking Behavior

In 1979, a longitudinal study was undertaken by the National Institute of Education involving the re-interview of 46.8 percent ($N = 1,194$) of the 2,553 adolescents first surveyed in 1974 (130). In 1974, 152 respondents were smokers and 1,042 were nonsmokers. By 1979, 27 percent ($N = 41$) of the smokers had quit, while 73 percent ($N = 111$) had continued to smoke. During the same time period, 20.8 percent ($N = 217$) of the nonsmokers had taken up smoking, while 79.2 percent ($n = 825$) had not. Thus, the proportion of smokers who had quit was greater than the proportion of nonsmokers who had taken up the habit. However, because the percentage of nonsmokers was much higher than the percentage of smokers, the net effect was an increase in the percentage of the population who were smokers (12.7 percent to 27.5 percent).

With each increase in age group, the proportion of boys who initiated smoking became smaller, so that boys who reached age 17 or 18 as nonsmokers were not likely to start in the next five years. Only 15.4 percent did so, compared with 19.3 percent of 15 to 16 year olds, and 21.6 percent of 12 to 14 year olds. For girls, the pattern is less clear. Fifteen to 16 year old nonsmokers in 1974 showed the greatest proportion of initiators (27.1 percent) by 1979. In the 12 to 14 age group, 22.8 percent took up smoking, and only 14.7 percent in the 17 to 18 age group did so.

Demographic and psychosocial relationships studied in 1974 were reexamined in this group now aged 17 to 23. The influence of older siblings became less powerful than the influence of peers, but educational attainment was still inversely correlated with smoking status.

Those smokers who had quit had a shorter lifetime history of smoking and were lighter smokers than those who were current

smokers in 1979. Of the former smokers, 24.7 percent said they had been smoking less than daily just before quitting, and another 34.5 percent smoked 1 to 14 cigarettes per day. Only 7.6 percent of current smokers report less than daily consumption. This suggests that the former smokers may have been less dependent (psychologically or physiologically) upon cigarettes and may have found giving up the habit easier than heavier smokers. In fact, 50 percent of the former smokers succeeded in quitting on their first attempt, while 61.6 percent of current smokers had made one or more unsuccessful attempts to quit.

These young smokers were concerned about health issues. Sixty percent of current smokers had made at least one attempt, and another 20 percent would have been willing to quit if there were an easy way to do so. A greater percentage of young women than men (91.0 percent and 85.2 percent, respectively) expressed a concern about health effects of smoking. The risk associated with oral contraceptive use and smoking and the harmful effects on the fetus of smoking during pregnancy (130) may be responsible for this increased concern. Young women were more likely than young men to say that all cigarettes are equally hazardous (33.7 percent and 25.9 percent, respectively).

Multiple regression analysis was used to identify those adolescents most likely to take up smoking, and discriminant function analyses were used to predict future smoking for each stage—nonsmoker, experimenter, regular smoker, and ex-smoker. The best predictor of future smoking behavior was the adolescent's own perception of his or her future smoking behavior.

The best predictors of future smoking for never-smokers and experimenters were smoking by an older sibling, scores on attitude scales, and age. The chance that a nonsmoker will start smoking become smaller as the nonsmoker grows older. Once regular smoking was initiated, the variables of higher dosage, lower educational aspirations, friends who smoked, and lack of acceptance of the health risks of smoking predicted continued smoking behavior.

In summary, this study revealed that former smokers seemed more similar to experimenters than to regular smokers. Their smoking histories were shorter, and they had a lower dosage and did not have much difficulty quitting. Regular smokers, on the other hand, tried to quit or expressed an interest in doing so, and were bothered by the health hazards associated with smoking. Five years previously, they were able to accurately predict their current smoking status. Smoking was also more likely to be a behavior of their older siblings and peers. And lastly, both educational aspirations and attainments were lower for this group.

PREVENTION OF SMOKING AND CONSIDERATIONS FOR FUTURE RESEARCH

Prevention of the Initiation of Smoking

There are a number of ongoing interventions which attempt to prevent the initiation of smoking (34,58,59,125,198). These studies are directed at elementary, junior high, and high school students, and use an "inoculation" approach to prevention. Exposure to a small amount of information about pressures to smoke is accompanied by practice in coping and assertiveness strategies. The main types of influences in which students are instructed are peer pressures, parental modelling, and media pressures. Peer instructors are often used to maximize influence. Compliance in self-reporting smoking behavior is increased by the use of physiological measures of smoking, for example, salivary nicotine or expired air carbon monoxide, which may or may not be analyzed for the entire subject sample.

Dissemination of information about the health risks of smoking seems to be successful, at least on a superficial level. Ninety-six percent of all adolescents (and 91.6 percent of smokers) "strongly or mildly agreed" that smoking is harmful to health (130). Percentages were similar for boys and girls, and nonsmokers scored higher on all health-related questions than smokers. Almost 90 percent of adolescent smokers (87.9 percent of boys and 89.9 percent of girls) "strongly or mildly agreed" with the statement, "I believe the health information about smoking is true." Fishbein has pointed out, however, the potential importance of the difference between strong and mild agreement with such statements, and the lack of direct personal attribution involved (63). Only 60 to 65 percent of adolescent smokers expressed strong agreement, compared with approximately 80 percent of nonsmokers. Either reduction of cognitive dissonance by denial or actual lack of information may underlie this response pattern. Finally, a surprisingly high percentage of smokers feel (strongly or mildly agree) that it is all right to smoke if "you don't smoke too many." On this item, fewer girls (25.6 percent) were willing to endorse this statement than boys (43.3 percent).

Somewhat lower estimates of the acceptance of health information comes from the 1975 American Cancer Society (ACS) Survey (216). Of all adolescent girls 74 percent agree that smoking is as harmful for women as it is for men; 71 percent agree that smoking is harmful for young people as well as for older people; 56 percent agree that it is not safe to smoke low "tar" cigarettes; and 56 percent agree that smoking is as addictive as

illegal drugs. Comparable figures are not provided for boys, nor are the data broken down by smoking and nonsmoking categories. This survey further reports that 68 percent of the girls sampled were not warned about smoking by their doctors.

While 60 percent of female smokers began to smoke before the age of 13, only 48 percent attended an antismoking education program in school, and a mere 4 percent attended such a program in the sixth grade when they were approximately 12 years old.

These statistics suggest that smoking education and coping strategies should begin earlier in schools and should begin earliest for high risk groups.

Research Goals

The best evidence suggests that female cigarette smoking rates are declining. This change has occurred in more recent adolescent cohorts—those born after 1962. National surveys are likely to underestimate true rates, whether school, household, or telephone samples are used. Drop-out, absenteeism, lack of telephone accessibility, and belonging to a minority group all contribute to the sampling errors, which include underrepresentation of population subgroups whose rates are substantially higher than the norm. Accurately measuring these subgroups would enable scientists to better target interventions. Young black females appear to be one such group whose smoking rates well exceed the national average (33).

There is good reason to expect the heaviest cigarette use and other “problem behaviors” among those segments of the adolescent population who feel cut off from socioeconomic opportunity and mobility. The review of correlates of adolescent smoking shows that many of the variables that predict cigarette smoking bear a remarkable similarity to ones identified as predictors of marihuana and/or other illicit drug use. It is recommended that greater attention be given to models of behavior and socialization processes.

More prospective longitudinal studies need to be undertaken, based on varied samples of children. Data need to be collected about physical and emotional status, psychosocial outlooks and attitudes, family and peer relations, academic and recreational activities, family and school settings, and family and residential background. This information must be gathered early in childhood to record significant socialization influences which precede the onset of smoking behaviors and should be collected frequently enough to record significant changes close to the time they occur.

TABLE 4.—Smoking parameters observed in Hamburg, Germany, in 1971 and 1974

	Puff Number		Puff Duration (sec)		Puff Interval (sec)		Total Puff Duration (sec)	
	1971	1974	1971	1974	1971	1974	1971	1974
Men	10.2	10.9	1.47	1.47	52.9	42.1	15.0	16.0
Women	10.9	13.3	1.31	1.17	46.0	40.7	14.3	15.5
All	10.5	11.8	1.41	1.34	50.3	41.5	14.8	15.8

SOURCE: Schulz, W. (167).

Maintenance of Smoking Behavior

PATTERNS OF CIGARETTE SMOKING

Smoking patterns differ between the sexes. Schulz and Seehofer studied the smoking behavior of male and female smokers observed surreptitiously in public places. Puff number, duration and interval were measured (167). Women were found to leave a significantly longer butt length (approximately 2 mm longer) and had shorter puff durations than men (Table 4). However, they took a greater number of puffs and, therefore, had the same total puff duration (puff number x puff duration). These authors do not report gender data on inhalation patterns, which are crucial to determining dose. However, Creighton and Lewis reported no sex differences in puff volume in a small study of the inhalation patterns of eight men and eight women (39).

Data on smoking patterns were collected in surveys conducted in 1964, 1966, 1970 and 1975 by the National Clearinghouse for Smoking and Health (NCHS) (see Table 5). In each survey a greater proportion of men than women reported inhaling deeply into the chest and inhaling almost every puff. Men therefore may extract a greater dose of nicotine and the other constituents of cigarette smoke than do women. However, there is an increasing proportion of women who report smoking their cigarettes "as far as possible," in contrast to a decline in the proportion of men who reported this behavior (167,192,193,194). A slightly higher proportion of males reported letting "very little" of their cigarette burn without smoking it: 1970, 20.6 percent male vs. 18.0 percent female; 1975, 20.9 percent male vs. 18.6 percent female (193,194). These changes are often a correlate of heavier smoking. In sum, the observational data suggest that men and women have equal total duration of smoking per cigarette, and the national survey data suggest a larger proportion of males inhale deeply. In general, men smoke in a more hazardous way than do women. However, the smoking patterns of women are changing toward "more hazardous" smoking (see Part I of this Report).

In contrast to the minor changes that have occurred in the way an individual cigarette is smoked, there have been substantial changes in the percentage of both male and female smokers who smoke more than a pack per day (Table 6). A number of explanations may be offered for these data: (1) more lighter than heavier smokers may be quitting, resulting in a mean increase in daily consumption; (2) continuing smokers may be increasing consumption; (3) smokers newly initiating the behavior may be smoking more heavily than already estab-

TABLE 5.—Respondent-reported styles of cigarette smoking, current, regular cigarette smokers, selected categories, adults, United States, 1964–1975

	1964		1966		1970		1975	
	Male	Female	Male	Female	Male	Female	Male	Female
1. Inhaling deeply into the chest	36.5%	22.5%	31.8%	15.5%	34.3%	17.5%	30.3%	16.4%
2. Inhaling almost every puff	63.1	54.8	63.0	52.1	60.5	47.2	58.5	50.7
3. Smoking cigarette as far as possible	15.9	7.5	13.5	10.0	9.6	10.4	10.9	12.9

1. In 1964 and 1966, the questionnaire response was “as deeply into the chest as possible.” In 1970 and 1975, the questionnaire response was phrased “deeply into the chest.”

2. In each survey year, the questionnaire response was “inhale almost every puff of each cigarette.”

3. In 1964 and 1966, the respondent was asked to draw a line on a diagram of a cigarette, indicating the average length of the discarded cigarette butt length. In 1970 and 1975 the verbal questionnaire response was smoking cigarette “as far as possible.” The data for 1964 and 1966 correspond to those respondents indicating a discarded cigarette butt length no greater than 20 mm.

SOURCE: National Clearinghouse for Smoking and Health (192,193,194).

TABLE 6.—Estimates of the percentage of current, regular cigarette smokers who consume more than one pack per day, adults, United States, 1955–1976

Year	Supplement to Current Population Survey (17 yrs. and over) 21 cigarettes or more daily			Health Interview Survey (17 yrs. and over) 25 cigarettes or more daily			National Clearinghouse for Smoking and Health (21 yrs. and over) 25 cigarettes or more daily		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
1955	20.2 ¹	25.5	9.8						
1964							25.7	32.4	17.7
1965				19.9	24.5	13.7			
1966	21.6	26.3	15.7				27.2	34.7	16.9
1967	21.9	26.2	16.3						
1968	22.4	26.5	16.8						
1970				23.3	27.6	18.1	25.2	31.1	17.1
1974				24.7 ²	30.3	18.4			
1975							30.1	36.0	22.8
1976				25.3 ³	30.8	19.4			

¹18 years and over.

²Data provided by Health Interview Survey, National Center for Health Statistics.

³20 years and over.

SOURCE: U.S. Department of Health, Education, and Welfare (198).

TABLE 7.—Estimates of the percentage of current, regular cigarette smokers among white and black adults, aged 20 years and over, United States, 1965–1978

Year	White		Black	
	Male	Female	Male	Female
1965	51.5	34.2	60.8	34.4
1970	43.7	31.9	54.0	33.1
1974	41.9	31.8	55.3	36.8
1976	41.2	31.8	50.5	35.1
1978*	36.4	30.1	42.8	30.2

*NOTE: Results displayed as percentage of respondents with known smoking status aged 17 years and over.

SOURCE: U.S. Department of Health, Education, and Welfare (198).

lished smokers; and (4) declining “tar” and nicotine contents of cigarettes may be leading to compensatory increases in number of cigarettes smoked in order to maintain nicotine dosage (198).

Regarding type of cigarette smoked, the 1975 NCSH survey reported that more women than men smoked filter tip cigarettes (all types), 90.6 percent vs. 79.3 percent. Women seem to be innovators in changing smoking practices. Sixty-one percent of women and only 10 percent of men acknowledge changing brands at least once, and women lead the trend in adopting king-size, filter-tip and 100 mm cigarettes. On the other hand, women smoke cigarettes almost exclusively. Cigars and pipes are currently used by 18 percent and 25 percent of men, respectively, but by less than 0.5 percent of women. Less than 2 percent of women use snuff or chewing tobacco compared with 2.5 percent and 4.9 percent of men, respectively.

SMOKING PREVALENCE AND ETHNICITY

The prevalence of smoking in the population varies not only with age, sex, and socioeconomic status, but also with race and cultural background.

Table 7 presents smoking prevalence among white and black adults from 1965 to 1978 (198). Smoking has declined among men of both races, but prevalence has decreased only slightly among white and black females. Congruent estimates of prevalence and lower cessation rates among blacks have been obtained in other studies (66,183,201).

Despite their greater prevalence of smoking, black men and women smoke fewer cigarettes per day than whites (66,183).

Black women may suffer the worst aspects of sexism and racism with respect to occupational opportunity and financial compensation. Cigarette smoking may be related to assertion, inde-

pendence, and rebellion or to identification with behavioral patterns of black males. Adolescent dynamics have been studied more than those of adults (see the section on adolescent smoking cessation in this Part). Warnecke, et al. found that social and psychological correlates among black women are similar to those observed among white women (201).

Friedman, et al. examined smoking prevalence among Asian men and women—Chinese, Japanese, Korean or unknown—from the Kaiser Permanente Health Plan and found a smaller percentage of cigarette smokers than among whites or blacks. Asian women had the least frequency of current, established cigarette smokers, 23.1 percent, compared to 39.2 percent of white women and 42.1 percent of black women. Asians were also the least likely to inhale among most age-sex groups of smokers. There were fewer cigarette smokers among Chinese than among Japanese; this was particularly true for women and younger men (66).

PHARMACOLOGICAL EFFECTS OF SMOKING

One or more of the constituents of cigarette smoke may play a role in the maintenance of smoking behavior and help account for the difficulties many individuals experience when they try to quit smoking (198).

Nicotine

Nicotine is absorbed rapidly from the oral and intestinal mucosa, lungs, and skin. It is distributed throughout the body and is metabolized by several organs, including the liver. It is then rapidly cleared, primarily through the kidney. Nicotine has effects on several organ systems, including the autonomic nervous system, voluntary muscles, stomach, intestines, heart, and brain. Most of the pharmacological actions of nicotine are thought to result from its interaction with receptors of cholinergic nervous systems. Analysis of the physiological effects of nicotine is complicated by the abundance of those effects. Many organs receive input from several neuronal systems which are altered directly or indirectly by cholinergic activity. Furthermore, the effects of nicotine itself depend both on the dose and on the time course of drug administration: brief exposure or low doses cause excitation of cholinergic systems, while long exposure and high doses result in inhibition and paralysis.

Peripheral Effects

Nicotine produces a variety of changes in the autonomic nervous system due to simultaneous effects on both sympathetic

and parasympathetic systems. The end result is an increased heart rate and blood pressure; cold, clammy skin; increased acid production in the stomach; increased intestinal activity; and biphasic changes in salivation, with an initial increase followed by a decrease. Nicotine also increases respiration.

Central Effects

Nicotine produces tremors and causes water retention by a central effect on antidiuretic hormone release. Nicotine-induced nausea and vomiting reflect a complex interaction between central and peripheral effects. To date, no specific effects on complex emotions and behaviors have been demonstrated. Animals will self-administer nicotine under certain circumstances, indicating that it may have pleasurable effects.

A Possible Role for Nicotine in Smoking Maintenance

A strong argument has been made for classifying smoking as an addiction, with nicotine as the leading candidate for the addictive agent. Inhalation of cigarette smoke offers an effective way to administer nicotine. Absorbed rapidly, it travels as a highly concentrated bolus through the heart and directly to the brain and is then rapidly cleared. A smoker who smokes one pack per day can average around 70,000 such nicotine "injections" per year. In behavioral terms, smoking has many potential conditioned stimuli, ranging from the taste, sight, and feel of the cigarette itself, to the many social settings in which smoking takes place. If nicotine were a strong unconditioned stimulus, particularly when inhaled, then it would be easily understandable that smoking can become a remarkably persistent habit through connection of this unconditioned stimulus with the many associated stimuli.

Although nicotine has effects on essentially all major organs in the body, including the brain, the role of those actions in maintaining the smoking habit remains an important but unresolved area of research.

The nicotine hypothesis of smoking states that the pharmacological actions of nicotine are "reinforcing." The most likely site of this rewarding or reinforcing action is the brain, with the precise locus of reinforcement not yet determined. Inhaling smoke insures rapid delivery of nicotine to the brain. It takes approximately 13.5 seconds for an intravenous injection of nicotine in the arm to reach the brain; but by inhalation, the delivery time is 7.5 seconds (158). The plasma half-life of nicotine is approximately 30 minutes, and the pack-a-day smoker lights

up approximately every 30 to 40 minutes of the day. This suggests that the smoker is attempting to maintain a constant level of nicotine.

The nature of the reinforcing effect is sometimes described as an alteration of arousal. Stimulation may be subjectively experienced as increased alertness, a facilitation of concentration, or an aid to continued efficient performance in fatiguing tasks. Sedation, on the other hand, may be experienced as a tranquilizing or calming effect or as a reduction of some dysphoric state, such as anger. Smoking has been described as distinctly pleasurable following a meal or accompanying xanthines (coffee and tea) or alcohol. Pharmacologic and psychologic components to these subjective reports are beginning to be identified (70,78).

There is extensive literature describing acute and chronic nicotine administration in animals including a limited number of self-administration models. Tolerance to nicotine has also been described (81,88,112).

A number of studies have examined the hypothesis that humans self-administer tobacco in order to obtain nicotine. Studies have also examined compensatory adjustments in the number of cigarettes and manner of smoking by subjects in response to experimenter-induced increases or decreases in cigarette nicotine content, cigarette size, availability, or supplemental nicotine administration. Chewing gum containing nicotine, nicotine tablets, intravenous nicotine and central or peripheral nicotinic blocking agents have been used to supplement or block the effects of the nicotine absorbed from the smoke. A titration effect is said to occur if subjects change their cigarette smoke intake in the appropriate direction in response to these experimental manipulations.

A modest amount of compensation has usually been demonstrated (79,158). Smokers seem to titrate along the nicotine, rather than the "tar" continuum but an optimum ratio of nicotine to "tar" probably exists for effective delivery to the lung. Experiments involving the intravenous administration of nicotine have been inconclusive, with both positive and negative effects on the suppression of subsequent smoking having been observed. When compensation occurs, it is seldom complete. This may be due to a number of factors: (1) the inability to accurately measure the smoker and/or nicotine dose delivered to the subject; (2) technical problems in experimental design (79,198); (3) secondary reinforcing effects of smoking which mask titration; and (4) the fact that people may smoke for reasons other than regulation of nicotine level.

Some have even suggested that nicotine controls smoking behavior only at the extremes, and then as an aversive agent (163).

Too much smoking might lead to such high serum concentrations of nicotine that toxic effects encourage lower intake; and too little smoking or smoking of low-nicotine cigarettes could lead to such low concentrations that withdrawal side effects encourage resumption of smoking. This hypothesis states that, between those two extremes, other factors such as psychological and social pressures are far more influential in determining smoking patterns.

Differences in Nicotine Metabolism

The metabolism of nicotine may be different in men and women. Measurement of nicotine and cotinine (the principal metabolite of nicotine) excreted in the urine after intravenous administration of nicotine hydrogen tartrate suggested differences in metabolism based on sex and smoking status (73). In nonsmokers, men excreted less nicotine but more cotinine than women, suggesting greater initial metabolism among men. However, there were no clear differences between male and female smokers.

Schievelbein, et al. studied nicotine and cotinine excretion in both regular smokers and nonsmokers after they smoked cigarettes with differing tar and nicotine levels (165). Women excreted significantly lower amounts of nicotine and cotinine compared with men for three of the four brands tested. The gender difference was found for the excretion of nicotine and cotinine when tested separately and together. The number of cigarettes smoked per day did not differ between the sexes, but the carboxyhemoglobin (COHb) levels, which are often taken as a correlate of depth of inhalation, were lower in the women. The female subjects, therefore, may have received a lower dose of nicotine because of a different smoking pattern.

SMOKING AND STIMULATION EFFECTS

The literature suggests that women are more likely to smoke in situations of high arousal than low arousal and when experiencing "negative affect" (69,96). The effects of smoking, which are often perceived as tranquilizing, might then be sought as a major coping mechanism. However, it can also be argued that the stimulant effects of nicotine, which are usually considered the predominant central nervous system action, might be equally useful as a mobilizer. These related and commonly held beliefs will be examined in some depth.

Frith (69) studied British male and female employees in a psychiatric institute; they ranged in age from 28 to 50. Subjects rated the strength of the desire to smoke in 22 hypothetical